agricultural research

U.S. DEPARTMENT OF AGRICULTURE JULY 1979

agricultural research

July 1979/Vol. 28, No. 1

A Disquieting Thought

America has a water problem. In much of the West, farmers and ranchers depend on aquifers—large underground formations—which have, over many centuries, become filled with water. Like the giant Ogallala Aquifer extending from west Texas north into Kansas and Nebraska, these aquifers are being mined in some ways analogous to the mining of oil or natural gas. The water supply is being used far faster than the surface water can replace it. At the same time, surface water supplies are increasingly being diverted to urban and industrial uses. In the West, American agriculture is producing food and fiber while drawing upon increasingly limited underground water resources.

Within the last 10 years, 30,000 acres of irrigated Arizona farmland have seen the metamorphosis to barren land—as the water beneath them has receded so far down that it is cost prohibitive to pump it up. This is happening now in much of the West.

Irrigated agriculture in the West uses a lot of water—about 90 percent of all the water consumed, both surface and groundwater. And that water is now disappearing or becoming more expensive than agriculture can afford.

Several times as much food can be produced on irrigated as on non-irrigated land. This is why a decrease in available water for agriculture is so significant.

For the forseeable future, this will continue. But the fact remains that this country has an ample supply of water, albeit unevenly distributed. It has vast underground aquifers. It has 33 rivers that each flow with more than 7½ million gallons of water per minute. It has an average annual rainfall of nearly 30 inches. What America does not have is one central clearinghouse responsible for gathering information that now is available only from widely diverse sources. Which lands are going out of production due to a lack of water? Which lands are being brought back into production with new, water stress tolerant plants and increasingly efficient water use? And what is their relative productivity, in comparison with the lands that are being taken out of production?

One possibility is to better manage the existing supplies, and to develop more crops which do well with saline, or little water. Cotton, for example, can be grown with relatively poor quality water; sorghum requires less water than many other crops. Another possibility is to construct water projects such as the Salt River project in Arizona. This project, one of the most successful in the West, once used only surface water for irrigation, and later used wells as the demand for water from Phoenix increased. Now, the project involves recycling water for urban use. Such projects, including basic research in the area of plant stress, are expensive.

But the cost of not managing our total agricultural resources is their eventual and permanent loss—with the accompanying decline in production and its concomitant multiple effect on retail food prices.

A disquieting thought, at best.—*Robert W. Deimel*

Editor:* *Patricia Loudon
Assistant Editor:* *Michael A. Meliker

Contributors to this issue:
Lisa M. Bell, Stephen M. Berberich, Robert C. Bjork, Vernon R. Bourdette, J. Paul Dean, Peggy L. Goodin, Walter W. Martin, Mary Ellen Nicholas, Raymond G. Pierce, Dennis H. Senft, and Lynn C. Yarris.

COVER: A glass rod is used to place pollen on the pistils of an emasculated pear flower. Pear trees are threatened by fire blight disease—our cover story which begins on page 10 (0479X535–27).

AGRICULTURAL RESEARCH is published monthly by the Science and Education Administration (SEA), U.S. Department of Agriculture, Washington, D.C. 20250. The Secretary of Agriculture has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 15, 1982. Yearly subscription rate is $10 in the United States and its territories, $12.50 elsewhere. Single copies are 90 cents domestic, $1.15 foreign. Send subscription orders to Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Information in this magazine is public property and may be reprinted without permission. Prints of photos are available to mass media; please order by photo number.

Bob S. Bergland, Secretary
U.S. Department of Agriculture

Anson R. Bertrand, Director of
Science and Education

Syphoning Spillways for Longer Pond Life

On this reservoir, where SEA engineers operate a prototype of the new spillway, Rausch takes water samples to measure the efficiency of the new spillway (0975X1799–6A).

An automatic type of reservoir spillway, recently developed and tested by SEA scientists, extends the life expectancy of small agricultural reservoirs and improves reservoir water quality. The new spillway can save farmers and others millions of dollars annually in dam construction costs.

David L. Rausch, SEA agricultural engineer, and Herman G. Heinemann, SEA research hydraulic engineer, call their development an "automatic bottom withdrawal spillway."

The scientists say that the life, or length of service, of a reservoir usually depends on how much soil sediment and other pollutants it collects each year. In this sense, they say, a reservoir starts dying as soon as it is created because it immediately starts to retain most of its incoming sediment.

The automatic bottom withdrawal spillway, however, delays the death of a reservoir by syphoning sediment-laden water from the bottom. Conventional spillways, frequently consisting of an overflow pipe and/or an area of firmly sodded ground, remove what is usually the best quality water—that from the top of the reservoir.

By syphoning bottom water, the new type of spillway removes the poorest quality water, slows the accumulation of sediment, and, therefore, preserves the usefulness of the farm pond or larger reservoir for watering livestock, raising fish, fighting fires, swimming, or irrigating crops. Heinemann and Rausch also say that because future dams built with bottom withdrawal spillways will retain less sediment, reservoirs can be smaller and less expensive to construct.

Here is how the new spillway works: A pipe runs from the bottom of a reservoir to the surface of the water next to the reservoir's dam. The pipe continues

through the dam to the downstream channel. At the apex of the pipe, there is a small, adjustable air vent, which controls the syphoning action.

When the reservoir's water level rises above the apex of the pipe, as a result of rainfall and runoff for instance, bottom water starts flowing through the pipe. When the water rises above the air vent, the air trapped inside is removed by the flowing water, and high-speed syphoning begins. This quickly removes suspended clay and silt particles along with associated nutrients. When the water level drops below the air vent again, syphoning stops.

The height of the air vent can be preset to control the surface level of the reservoir. In this way, a farmer can periodically lower the water level to control the buildup of unwanted aquatic plants or to improve waterfowl habitat.

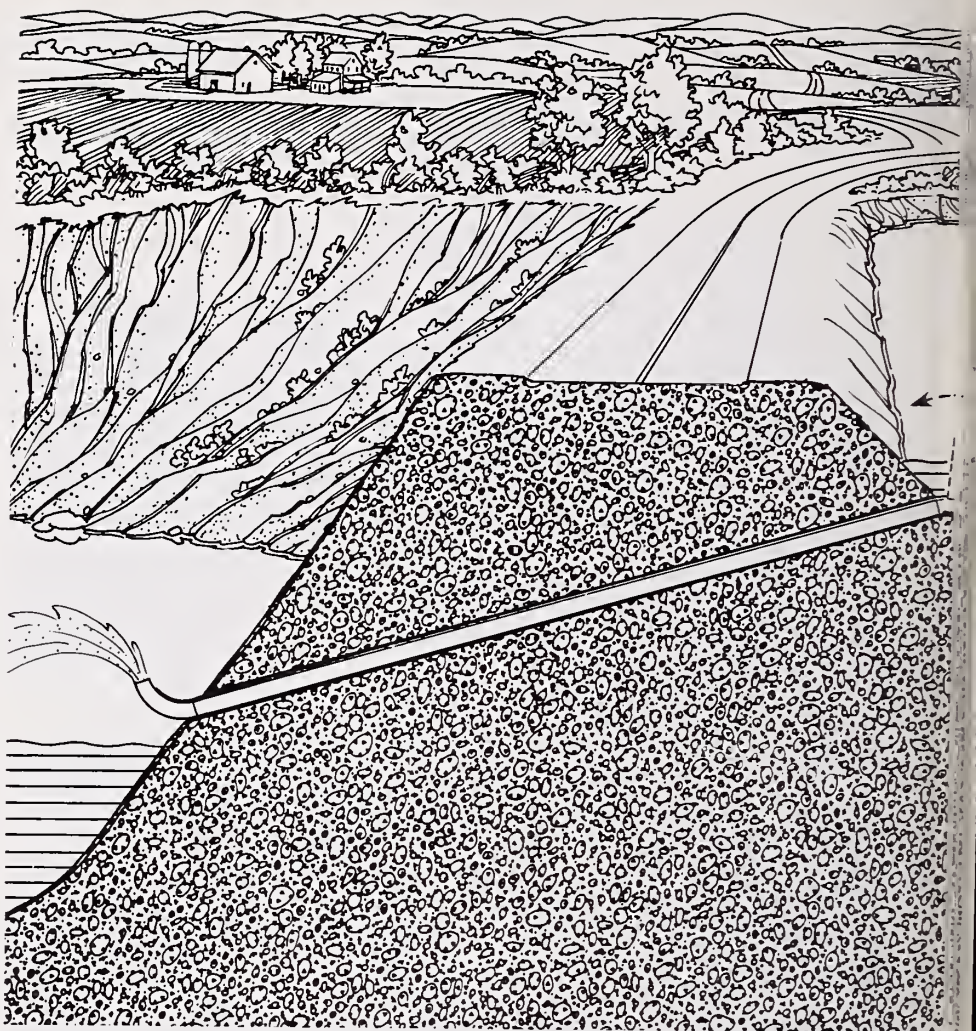
Where the system empties downstream, the spillway pipe makes a sharp upward turn in order to aerate outflowing water and to help reduce erosion.

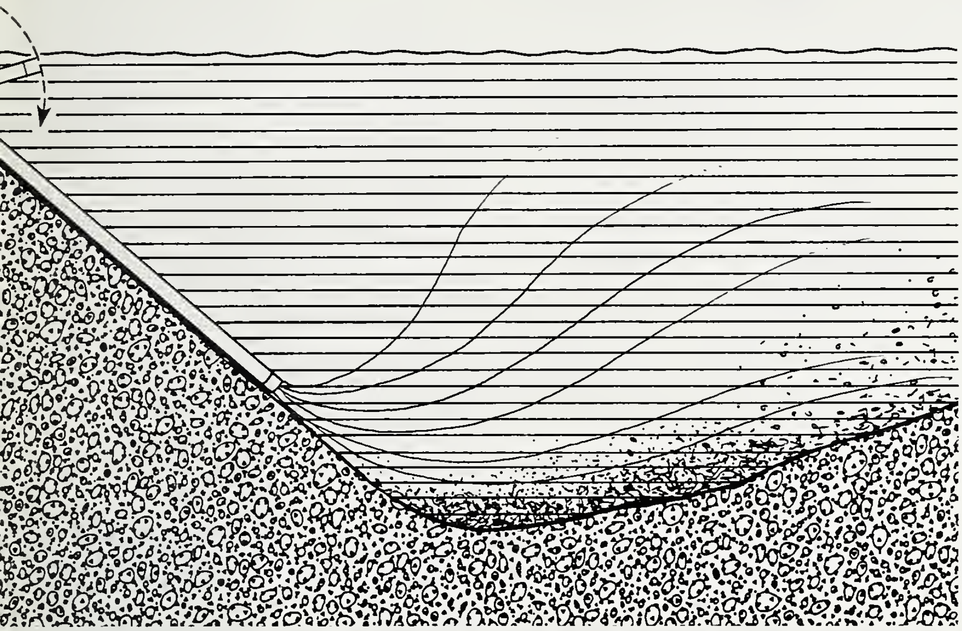
Heinemann recently came to SEA's Beltsville Agricultural Research Center in Maryland from the SEA Watershed Research Unit in Columbia, Mo.

At Columbia, the scientists have prototypes of their spillway idea installed at three privately owned reservoirs. The largest is a 10-acre reservoir on a 235-acre watershed (the land area that drains into a reservoir) where the automatic bottom withdrawal spillway has operated flawlessly for 3 years. Those at the other two reservoirs have also operated without problems for 3 and 5 years respectively.

The automatic bottom withdrawal system on the largest reservoir consists of 60 feet of 18-inch corrugated pipe, attached to an existing 18-inch steel overflow pipe. A piece of 2-inch diameter pipe is attached as an air vent.

Rausch's address is Watershed Research Unit, 207 Business Loop 70 East, Columbia, MO 65201. Heinemann's address is Hydrology Laboratory, Room 139, Bldg. 007, BARC–West, Beltsville, MD 20705.—S.M.B.





Left: *SEA's new type of spillway syphons bottom water automatically with an adjustable air vent at the top of the spillway pipe (PN 4188).*

Far left: *Most dam spillways remove what is often the best quality water—that from the top of a reservoir. Here Rausch holds a bag of such "top" water in his left hand and a bag of sediment-laden water in his right hand (0975X1800–6).*

Left: *Rausch checks the self-adjusting air vent of the new spillway. The height of the air vent can be preset to control the level of the reservoir (0975X1800–22).*

Striking Oil With Okra

In 30 years the world must produce as much food again as it has produced since the dawn of time. Although gumbo is hardly the answer to world hunger, one of its main ingredients—okra—may one day be a strong source of protein and oil for nations in the tropical belt.

SEA and University of Puerto Rico scientists have found okra to have a protein production potential second only to wheat and soybeans. Okra also could compete with safflower in oil production.

In some areas, such as Brazil, okra is so trouble-free that it is known as a crop that always pays. Okra seeds are produced in abundance and are easy to harvest, clean, and store by simple as well as large-scale techniques. They can be milled and sifted to provide a useful meal, or after grinding they can be extracted with water. Protein and oil can be precipitated by simple techniques.

Most studies of okra production concern only the immature green pod used as a vegetable. This first study to determine the effects of spacing on seed, protein, and orka oil production took place at the University of Puerto Rico. There, agronomist Gerardo Mangual Crespo and SEA horticulturalist Franklin W. Martin found that the average production of okra seed is comparable or superior to protein and oil production of many crops in the temperate zone and the tropics.

Seed production was studied in two experiments in Coto Clay soil, an acid Oxisol, in Isabela, P.R. The first experiment was an off-season study (November) with plantings of 8 commercial varieties. "Evergreen Velvet and White Velvet were slow to develop in the off-season, but the plants became large and are heavy bearers. They can be considered possible winter varieties for Puerto Rico," says Mangual.

The second experiment of 4 varieties was planted in July, a normal planting date for okra.

The most productive varieties were Clemson Spineless, White Velvet, Evergreen Velvet, and Red Okra. Comparing protein production in kilograms (kg) per hectare of okra to other important crop plants, Clemson Spineless at 658 kg per hectare clearly exceeded maize, potato, cabbage, and safflower (504 kg, 412 kg, 444 kg, and 435 kg) and competed with wheat and soybean (752 kg and 750 kg).

In oil production, Clemson Spineless at 612 kg per hectare was second only to the African oil palm (2200), which is recognized as far outranking all other sources. Evergreen Velvet and Red Okra competed with or exceeded soybeans, sunflower, sesame, peanuts, and castor.

The highest production of most varieties is achieved with 6 or more plants per square meter. According to Mangual, in the testing of existing varieties or the development of new varieties, close spacing should be the rule in order to give potentially productive varieties an opportunity to demonstrate their usefulness.

"Okra plants grow to fit the space allotted to them," said Martin at SEA's Mayaguez Institute of Tropical Agriculture. "Plants with as much as a meter of growing space will become very large and bear many pods. As plant density increases, the total fruit yield increases but yield per plant decreases. Therefore an optimum plant density must be found."

Maximum seed yields can be obtained in the case of Clemson Spineless with 58,000 to 86,000 plants per hectare. Clemson Spineless can tolerate the closest spacing and is the highest yielding variety, ranging from a low of 1.18 to 4 tons per hectare, about 25 percent better than the "gumbo" State of Louisiana.

Dr. Gerardo Mangual Crespo is with the Agricultural Experiment Station, University of Puerto Rico, Isabela, P.R. 00662. Dr. Franklin W. Martin is with the SEA Mayaguez Institute of Tropical Agricultue, P.O. Box 70, Mayaguez, P.R. 00708.—P.L.G.

Tailoring Vegetable Proteins

Vegetable proteins are good, but SEA scientists are making them better by tailoring them to improve their nutritive value.

As vegetable proteins come from peanuts, soybeans, cottonseed, and other oilseeds, their amino acid profiles differ and all are deficient in one or more of the essential amino acids.

SEA chemists Leah C. Berardi and John P. Cherry are changing all this by developing ways to tailor-make proteins to improve the amino acid profile.

Greatly simplified, the technique involves blending flours from the various oilseeds in some desirable proportion and extracting the protein with a dilute sodium hydroxide solution. Following extraction, the solution is acidified to pH 2.5, then readjusted to 5 to precipitate protein curds. The curds are recovered by centrifugation, resuspended in water, neutralized, and dried. The conditions can be altered to control the composition of the final product.

During the procedure, the proteins in the extracts dissociate into subunits at pH 2.5 and then reassociate either into their original form, or into new forms as the pH is adjusted to 5.

The resulting coisolates are more than 95 percent protein and represent more than two-thirds of the protein in the original blend of flours. They contain only small amounts of lipid, ash, and sugars, thus eliminating virtually all of the flatulence-producing sugars.

The essential amino acid content of the proteins in the coisolates usually exceeds that of the flours used in their preparation.

On an equivalent basis, there was more half-cystine in the coisolates than in the soybean flour, and more valine, isoleucine, threonine, methionine, phenylalanine, and tyrosine than in either the cottonseed flour or the soybean flour.

This method of improving the amino acid composition of vegetable proteins may result in fewer flavor problems than those imposed by fortification of proteins with purified amino acids. Still another advantage of the coisolate procedure is the ease of amending the procedure to suit the protein sources and final product requirements.

The research was conducted at the Southern Regional Research Center, P.O. Box 19687, New Orleans, LA 70179.—V.R.B.

Herbicide Controls Volunteer Corn

A new herbicide successfully controlled volunteer corn after 6 years of research at St. Paul, Minn., SEA research agronomist Robert N. Andersen says. When corn grows in other crops where it is not wanted, it is considered a weed that needs to be controlled.

He evaluated the herbicide, diclofop, on the "volunteer" offspring of 240 corn-belt hybrids and rated them for susceptibility and tolerance to diclofop.

"Volunteer corn from some hybrids may be somewhat tolerant of diclofop," Andersen said. "However, corn in general is so susceptible that even the most tolerant varieties can be controlled when diclofop is applied at the proper rate and the proper time, even though environmental factors are unfavorable for herbicide activity."

Working with Andersen was University of Minnesota corn breeder Jon L. Geadelmann.

"Earlier research—we started working on the problem in 1972—had shown a variation in resistance among corn inbreds," Andersen said. "We planted 240 corn-belt hybrids in 1976 and produced the volunteer generation for our research from the 1976 crop."

"We applied diclofop at one pound per acre to the corn-soybean plots on June 6, 1977. Three weeks later we rated the effect of the treatment."

Andersen said they repeated the experiment in 1978 using the 10 most susceptible entries and the 10 most resistant entries from the 240 tested in 1977.

Control was better in the 1978 experiments, probably because the corn was younger at the time of treatment, Andersen said. Even the most resistant entries in the 1977 experiments were adequately controlled in the 1978 studies.

Diclofop is being field tested on 5,000 acres in 13 mid-Atlantic and mid-Western states, but has not yet been registered by the Environmental Protection Agency for use on soybeans for control of volunteer corn.

Dr. Andersen's address is Weed Control Lab, Department of Agronomy, University of Minnesota, St. Paul, MN 55108.—R.G.P.

The Sunflower Bee

Whether they are called *Melissodes agilis* or sunflower bees, growers of sunflower will come to know these bees as "good friends." They are capable—through pollination—of increasing yield in sunflower grown for oilseed production and for nut and birdfood markets.

Sunflower is one of this country's most rapidly expanding crops. Over the past decade, planted acreage has been increasing by 67 percent per year, going from 222,000 acres in 1970 to more than 4 million acres last year. With the current high price on the world market for sunflower seed oil, sunflower is now in some places an even more profitable dryland crop than wheat.

Since sunflower is one of the few crops native to North America, a lot of native North American wild bees evolved with the plant. Franklin D. Parker, SEA entomologist at Logan, Utah, has so far found nine species of wild bees in just the Logan area that exclusively visit sunflower to gather nectar and pollen. In other sunflower-producing areas there are many more bee species.

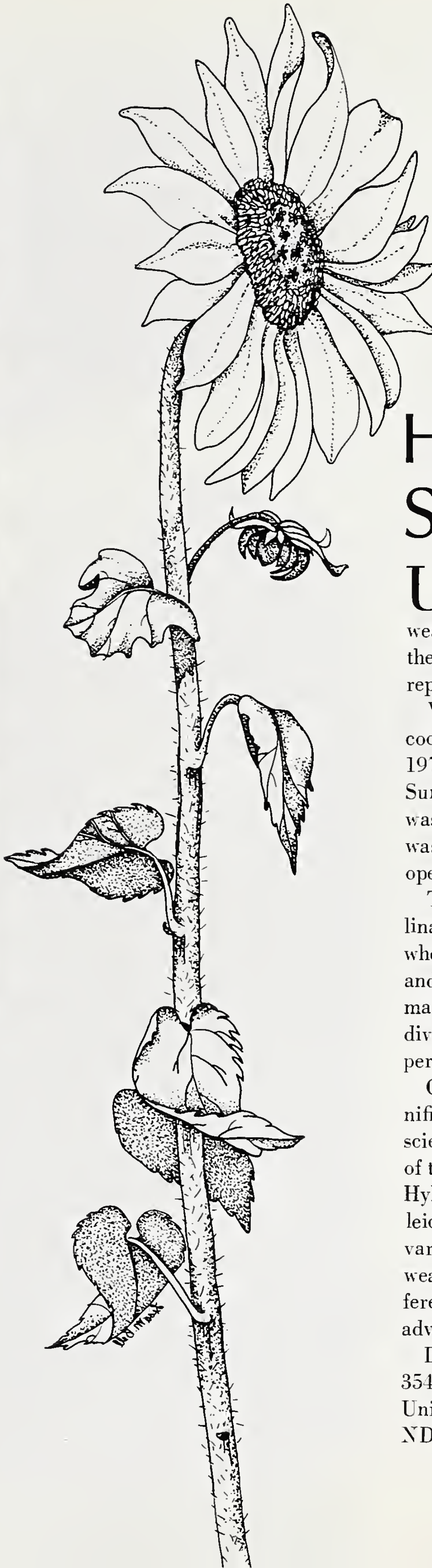
The best pollinator among these wild bees is *Melissodes agilis*. Females visit the sunflower head—which contains 1,000 to 2,000 individual flowers joined to a common base—to gather nectar and pollen for making bee bread to feed their young. Males visit the plant, too.

Pollination by *Melissodes* increased the number of seeds produced in all sunflower varieties observed by Parker, even those labeled as "self-fertile" (do not need insect pollination). Seed oil content was also boosted.

Some growers have been using honey bees to pollinate their crop, but honey bees are not as efficient sunflower pollinators as *Melissodes*. Unlike *Melissodes*, honey bees (females only) visit sunflower in search of just nectar; the pollen gathered is inadvertent. Furthermore. *Melissodes* visits sunflower early in the morning when the plant first sheds its pollen, while honey bees make their visits later, after much of the pollen has already been shed.

Parker is continuing to look for additional native bee pollinators of sunflower. As the industry continues to expand, the need for efficient insect pollinators will increase, too. Flower and bee have come this far together; their journey should undoubtedly continue.

Dr. Parker is located at the Natural Resources Biology Building, Room 261, Utah State University, Logan, UT 84332.—L.C.Y.



Hybrid Sunflowers

Under adverse growing conditions, even more than with favorable weather, hybrid sunflowers out-yield the open-pollinated varieties they are replacing.

Weather was favorable—unusually cool and wet in August and September 1977—at Casselton, N. Dak., where the Sunflower National Performance Trial was conducted. The yield advantage was 12 percent for five hybrids over two open-pollinated varieties.

The hybrids out-yielded the open-pollinated varieties by 44 percent in 1978 when the same 2 months were warm and dry, SEA chemist Don C. Zimmerman reports. Yield decreases for individual entries ranged from 17 to 44 percent in 1978.

Oil content of the seed was not significantly different over the 2 years, the scientist says. But linoleic acid content of the oil declined significantly in 1978. Hybrids had significantly higher linoleic acid content than open-pollinated varieties under favorable growing weather in 1977, but there was no difference between the two types under adverse conditions the next year.

Dr. Zimmerman's address is Room 354–A, Ladd Hall, North Dakota State University, University Station, Fargo, ND 58102.—W.W.M.

Disease Blights Perfect Pear

Roland C. Blake uses a glass rod to pollinate the pear blossom pistils (0479X536–24).

Like the prospector who searches for the elusive nugget of gold, Tom van der Zwet searches for the perfect pear—a pear that is lovely to look at, delicious to eat, and most of all resistant to fire blight, a serious bacterial disease.

Van der Zwet, a SEA plant pathologist, says fire blight resistance could do for pear growers what verticillium resistance did for tomato growers—allow it to be grown where it couldn't be grown before.

Fire blight is a distinctly American disease. It was here before the colonists arrived, and when pear orchards were planted in the mid-1880's the disease reared its ugly head. Our native plants, relatives of the pear, were apparently resistant to fire blight, but the new pears were vulnerable and the disease wiped them out.

Today, almost 100 years since those first orchards were destroyed, scientists are working to develop fire blight-resistant pear trees. The pears they are trying to develop would make it possible

to successfully grow pears in the East and other warm, humid areas where the disease thrives.

Now, pears are grown commercially in this country only in the cool, dry valleys of the West Coast. The few pear trees growing in the East and other fire blight-infested areas continuously suffer from blight and eventually die. Large commercial orchards of pears are particularly vulnerable to fire blight due to the concentration of the host plant.

Fire blight is aptly named because affected plants blacken and die as if swept by fire. The disease is caused by a bacterium that can be spread by rain, wind, insects, birds or man.

Blossoms are usually the first part of the tree to show signs of blight. A single blossom or a cluster may appear water-soaked, then wilt, shrivel and turn brownish or black. The disease can move down the stem and into the trunk. Once the bacteria reach the trunk, the tree is doomed. If caught in time, the affected limb can be cut off and burned, preventing the spread of the bacteria into the trunk.

At the Beltsville Agricultural Research Center, van der Zwet's search for fire blight- and insect-resistant pears is no small task. It can take from 5 to 7 years from the time the pear seed is planted until the first fruit appears.

"Our research on fire blight was started in earnest in 1961 and by the turn of the century, perhaps we will have a resistant pear tree," says van der Zwet. SEA horticulturalist Roland C. Blake at the Ohio Agricultural Research and Development Center is helping van der Zwet in his search.

"Because it can take 30 years or more to develop disease or insect resistance, we breed for resistance to more than one pathogen at one time," says van der Zwet. "It would be foolish to work for 25 years to develop a blight-resistant pear, and then start over again and work for another 30 years to build in insect resistance. So, we are working not only with fire blight, but with psylla resistance as well."

Psylla is a tiny sucking insect that is a worldwide pest of pears. Not only do the insects reduce yield by sucking juices and damaging leaves, but they leave a residue on the trees which supports a fungus growth. And, the insects spread a serious virus disease of pears.

This vial contains enough pollen to pollinate thousands of pear blossoms (0479X538-3).

Wayne Zook, biological technician, collects pollen from pear blossoms. Branches selected for pollen collection are cut while the blossoms are still closed. The branches are brought indoors and placed in crocks of water. When the blossoms open, the pollen is collected (0479X537-29A).

To prepare the trees for pollination, van der Zwet (foreground) and assistants remove the petals and anthers of pear blossoms (0479X536-36).

Special scissors are used in removing the petals and anthers, leaving only the pistils to receive the pollen (0479X534-32).

"Insect and disease resistance offer the ultimate solution to pesticides," says van der Zwet. "With disease and insect resistance, we would not only have healthier trees, but a healthier environment as well."

"The odds on finding resistant seedlings are staggering. Only about one in 100,000 seedlings offers any promise of combining both fire blight resistance and quality. And, the odds go up considerably when you throw in psylla resistance as well."

"To combine both quality and disease resistance can take between six and seven generations of pear breeding and when one considers that a generation is between 5 and 7 years, that's 30 to 50 years to develop a resistant tree," says van der Zwet. "Many researchers spend their careers working toward a goal they never attain. They must pass their project on to the next person. For me, plant breeding is the ultimate challenge in research."

Pear breeding is not only time-consuming, but requires meticulous records and careful attention to details. All records from the breeding program are recorded and analyzed by computers. The computers also help select the parent plants that will transmit the greatest amount of disease and insect resistance to the next generation.

The search for a commercially acceptable resistant pear has a unique twist. Normally, resistant strains are found where the disease is present—those surviving have weathered the storm, so to speak. With fire blight, this is not the case. The disease was first found in America, where there were no pears before the settlers, but the resistant trees are found in China, where there is no disease. "A possible explanation of course, is that the disease once existed in China," says van der Zwet.

The pears used in developing a high-quality resistant pear are from China. These pears, though highly resistant to the disease, have a flavor and texture that are not suitable to American palates. The Chinese pears are crossed on our commercial varieties that have the flavor, texture, and appearance desired by consumers.

Though pears are probably the most economically important crop that is attacked by fire blight, the disease attacks all Rosaceous plants. These include apple, cotoneaster, hawthorn, quince, pyracantha and mountainash.

Since 1957, the disease has spread to northwestern Europe where there are no large fruit-growing areas, but where there are thousands of acres of susceptible ornamentals. There, fire blight threatens this valuable and productive industry.

Van der Zwet has traveled widely and sampled some of the finest pears in the world. He says you can't imagine how good a pear can taste until you have tasted some of the finest varieties grown in other countries. Perhaps some day we will have that chance.

Dr. van der Zwet is located in Room 12, Bldg. 004, BARC–West, Beltsville, MD 20705.—M.E.N.

Exported Watermelons Make Their Mark

U.S.-grown watermelons are turning up on Swedish smorgasbords and getting to be Britain's "cup of tea." Both countries, among others, have become new overseas markets for the American melon.

Accordingly, the longer shipping times required for melons to reach European markets have sparked SEA studies to determine the effects of field-applied fungicides, temperatures, and length of storage time on postharvest quality of various new varieties.

Scientists at the U.S. Horticultural Field Station and the University of Florida now believe that the combined use of preharvest treatment and 60°F (15.6°C) shipping temperature could not only reduce losses in domestic shipments, but increase successful exports to Europe.

Postharvest decay, principally blackrot, was examined in a preliminary test of four watermelon varieties that had been stored at different temperatures for different lengths of time.

Fruits of three newer watermelon varieties, 'Smokylee', 'Crimson Sweet', and Fla. 75–1, and of the standard 'Charleston Gray', were stored at 45°F (7.2°C), 50°F (10.0°C), and 60°F (15.6°C). Some were removed after 4, 7, and 14 days, which are the usual transit times for domestic and overseas shipping.

The melons were held at 70°F (20°C) for 7 days to determine shelf life. Decay incidence was highest for the newest variety, Fla. 75–1. It varied directly with storage time, and inversely with storage temperature in all four varieties.

In a second test, 'Charleston Gray' and Fla. 75–1 melons were field-treated with two levels (high and low) of fungicides, captafol and mancozeb—which are also used to control gummystem blight in the field. The melons were stored at the same temperatures and times, and then held for 1 week at 70°F to simulate marketing.

Less decay developed on 'Charleston Gray' during storage and holding than on Fla. 75–1. The high-level fungicide treatment reduced decay in both varieties. Melons stored at 60° prior to marketing had less decay than those stored at 45°F.

"Although 'Charleston Gray' usually reaches its destination in good condition when shipped according to current domestic practices, our tests demonstrate that losses due to decay could be minimized by use of a good preharvest fungicide schedule and shipment at 60°F," said biological laboratory technician Alice T. Dow. Under these test conditions of fungicide treatment and shipment temperature, even Fla. 75–1, which is highly susceptible to blackrot, could be shipped successfully, says the scientist.

Fla. 75–1 is currently being considered for release by the University of Florida's Agricultural Research Center in Leesburg. It is more resistant to fusarium wilt and develops a more intense red flesh color and higher sugar content than other varieties.

Alice T. Dow worked on the study with plant pathologist Raphael H. Segall (deceased), at the U.S. Horticultural Field Station, 2120 Camden Rd., Orlando, FL 32803, and with plant pathologist D. L. Hopkins and horticulturist G. W. Elmstrom at the University of Florida, Institute of Food and Agricultural Sciences, Agricultural Research Center, Leesburg, FL 32748.—P.L.G.

(Photo courtesy Grant Heilman)

Space Dyeing Livens Fabrics

In today's fashion market, consumers are looking for novel coloration in clothing, carpets and upholstery. One way to achieve this unique coloration is through space-dyeing—intermittent coloring of yarns in various shades. When woven or knitted into fabric, the yarn forms unusual and attractive designs, such as random or repeat coloration.

SEA scientists in Berkeley, Calif., have developed a fast space-dyeing technique that requires neither additional handling nor processing equipment—factors that add to production costs.

Another advantage of the technique is that, while developed for wool, it can be used for all fibers. These include natural (wool or cotton), synthetic (rayon or polyester), or combinations of materials.

To produce space-dyed yarn, chemist Richard O'Connell uses yarn that is normally wound on cylindrical tubes. These tubes are perforated to allow dye to flow through the yarn. But O'Connell restricts the flow of dye to only certain areas of the cylinder.

He does this by wrapping an impervious material such as film or foil around the tube or blocking holes in the cylinder, or a combination of the two. A tight metal clamp around the yarn also restricts dye flow. Either horizontal or vertical areas of the spool can be made impervious to the dyeing process.

After dyeing, yarn is drained, rinsed, dried, and processed into fabric on conventional equipment.

A repeat pattern is produced if only one yarn is knitted at a time. A random pattern results if several yarns are knitted together. Two-tone effects are possible if protected areas are exposed and dyed areas are protected with a repeat dyeing using a second color.

(Photo courtesy American Textile Manufacturers Institute, Inc.)

"Our technique certainly is cheaper and faster than those currently used. One technique used today requires yarn to first be knitted into fabric, printed with a pattern, unraveled, and woven or knitted into still another fabric," said O'Connell.

Dr. O'Connell is at the Western Regional Research Center, 800 Buchanan Street, Berkeley, CA 94710.—D.H.S.

No-Twist Cotton – a Better Yarn

A SEA research team has developed a promising new technique for producing no-twist cotton yarns. This achievement could lead to a minor revolution in the textile industry, where spinning is the most costly of several yarn manufacturing steps.

Successful development of this workable method for producing no-twist yarn can lead to a totally automatic yarn production system. Such a system would lower costs by eliminating three processing steps and by reducing floor space, labor needs, and dust controls.

The idea of no-twist yarn is not new. A number of techniques have been tried in the past, but successful commercialization has been very limited. This new method was developed at the Southern Regional Research Center in New Orleans by engineers Harold L. Salaun and Gain L. Louis, and textile technologist Roger S. Brown.

The limited spinning rate of conventional equipment has long been a bottleneck in the overall production of yarns for weaving and knitting. The recent development of what is known as open-end spinning has increased production substantially, but still the inescapable need to impart twist to hold the fiber together remains a limiting factor in yarn production.

The new system uses a liquid binder instead of twist to hold the yarn together. The binder is washed out of the finished fabric.

What occurs during formation of the no-twist yarn is deceptively simple.

Raw cotton is fed to a standard carding machine, where the fibers are separated and formed into a thin, delicate web.

As the web leaves the card it is separated into 3-inch strips, each of which is led to a special comber-drafter unit to parallellize the fibers, and then through a funnel-like device to form a rounded strand. The strand is then wetted with the liquid binder, dried, and finally wound into a "cheese type" package or cone, depending on the end use of the yarn.

The strength of the experimental no-twist yarn is about 45 percent less than conventional ring-spun yarn and about 28 percent less than open-end spun yarn. Also, yarn elongation at break and uniformity are less than would be expected from a spun yarn.

Normally, a conventional yarn exhibiting such poor properties as the no-twist yarn would be expected to produce low quality fabric. However, the no-twist yarn is not a conventional yarn, say the researchers, and is not limited by the conventional concept of yarn-to-fabric transformation.

The three types of yarn—no-twist, ring, and open-end—all from the same cotton source, were woven separately as filling yarns in a filling-face sateen weave.

Bursting strength of the fabric made with no-twist yarn was greater than either of the other fabrics. But grab-breaking strength was low, probably due to the sateen weave which exposes more of the filling yarn than warp yarn.

Even with more of the filling yarn exposed on the face of the fabric, flex abrasion was only 9 percent less than that of ring-spun yarn, and was an unexpected 68 percent better than that of the open-end yarn fabric.

Air permeability of the fabric made with no-twist yarn was substantially below that of the other fabrics. This may make no-twist yarn ideal for thermal fabrics and good filtration fabrics. It may also offer superior woven and knitted materials for use as base fabrics in the large vinyl-coated fabric market.

Plain jersey fabrics were knitted from all three types of yarn.

The jerseys, when laundered, were similar in total shrinkage, but the no-twist fabric shrank mainly in the width while the others shrank about equally in both directions.

Both the ring and open-end yarn knits showed a twisted effect along the length of the fabric because of the twist torque in the spun yarn. The fabric knitted from no-twist yarn showed no inclination to twist. As a result, the spiral effect of the conventional fabrics caused them to twist and fold during wet finishing processes, while the no-twist yarn fabric remained as flat as a woven fabric.

The researchers are located at the Southern Regional Research Center, P.O. Box 19687, New Orleans, LA 70179.—V.R.B.

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Lowering Oxygen Controls Insects

It isn't exactly a new idea.

Ancients in India buried grain in sealed pits and lighted a candle in the chamber. Those same people sometimes simply filled the chamber and let the natural metabolism of the grain, and in some cases, fungi, get the job done. Some present day groups, believing in storing emergency food supplies, place grain in large sealed containers along with dry ice—carbon dioxide (CO_2). The Japanese store grain in sealed plastic bags under water.

What all that effort is about is the lowering of the oxygen level in those spaces to limit insect activity. The modern term for the technique is "controlled atmosphere." CA in this context is low oxygen. Refrigeration is a type of CA, as is vacuum packing.

Insects, like most living things, need oxygen to survive. The less oxygen, the less survival.

SEA entomologist Edwin L. Soderstrom, Fresno, Calif., is updating information on the method used for storing fruits and nuts before packaging. He is also seeking a safe, reliable, nonpolluting substitute for present fumigants—methyl bromide and phosphine—which someday may not pass rigid regulatory standards.

At present, Soderstrom is conducting small-scale studies injecting bottled gases low in oxygen into small jars containing a variety of insects. He's doing that to find the best mix of nitrogen, CO_2 and oxygen, as well as humidity and temperature levels best suited for insect control. Later he'll be using large chambers and burners that will remove oxygen.

The entomologist finds that by reducing the oxygen level to about 50 percent, CO_2 at 9 to 11 percent, and the rest nitrogen, insects do not survive. With that mixture, mortality patterns show the merchant grain beetle and red flour beetle dead at about 55 hours. The Indian meal moth lasted a little longer and succumbed at about 80 hours.

Controlled atmospheres are being used today in the storage of some foods to slow down oxidation to help preserve quality.

Other advantages of using low oxygen atmosphere to control insects are the reduction of poisoning danger to workers, no residue problem, and no chemical injury to foods. A fringe benefit is that the lack of oxygen in such storage areas lessens the danger of fire in such spaces.

Cost of the CA treatment, Soderstrom estimates, will be about the same as phosphine and a little higher than methyl bromide.

The study is being funded in part by the Almond Board of California and the California Raisin Advisory Board.

Dr. Soderstrom is located at the Stored-Product Insects Research Laboratory, 5578 Air Terminal Drive, Fresno, CA 93727.—J.P.D.

Into the can

New markets at home and abroad may open up for the high-yielding Garfield dry pea, as a simple soaking process can now make the variety firm enough for canning.

Garfield was developed by SEA plant geneticist Frederick J. Muehlbauer, Pullman, Wash., to replace the Alaskan dry pea as the standard canning variety. Garfield is more disease-resistant than Alaskan. Because of its larger size, it has outyielded the older variety by up to 25 percent per acre. Until now, Garfield has fared poorly as a canning pea; it turns soft and mushy under normal processing treatments.

Stephen R. Drake, SEA food technologist at Prosser, Wash., has discovered that soaking Garfields in a 0.05 percent calcium-chloride solution firms them to the same levels of sturdiness as Alaskan peas, while maintaining their significant size and consequent yield advantage.

Dry peas grown in Washington, Oregon, and Idaho, are today part of a $100 million plus industry. A Garfield pea acceptable for canning by domestic and foreign markets could substantially add to this figure.

Dr. Drake is located at the Irrigated Agriculture Research and Extension Center, P.O. Box 30, Prosser, WA 99350. Dr. Muehlbauer is located at Room 275, Johnson Hall, Washington State University, Pullman, WA 99164.—L.C.Y.

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

U. S. GOVERNMENT PRINTING OFFICE : 1979 O - 296-287